CLAIMS

What is claimed is:

1. A method of using a multiple cell power supply in an implantable cardiac stimulation device, comprising:

connecting a fast battery cell to an output node to power stimulation device functions;

connecting the fast battery cell to a dense battery cell having a greater power capacity than the fast battery cell, so that the dense battery cell is capable of recharging the fast battery cell upon demand;

detecting if the fast battery cell or dense battery cell becomes a failing battery cell;

electrically disconnecting the failing battery cell from the other battery cell and from the output node;

allowing the other battery cell to replace the failing battery cell in powering the stimulation device functions; and

providing a warning signal upon disconnection of the failing battery cell.

2. The method according to claim 1, wherein the fast battery cell and the output node are connected by a fast intervening switch that is normally closed, so that the fast battery cell substantially provides the energy required by the output node.

3. The method according to claim 2, wherein the fast battery cell and the dense battery cell are connected by a dense intervening switch that is normally closed, so that as energy is drawn from the fast battery cell by the output node, the fast battery cell is recharged by current flowing from the dense battery cell.

4. The method according to claim 3, wherein the dense battery cell and the output node are connected by a third intervening switch that is normally open.

5. The method according to claim 4, wherein detecting the failing of a battery cell comprises monitoring a current sensor that is positioned between the fast battery cell and the dense battery cell, so that a signal proportional to the current flow from the dense cell to the fast cell may be measured.

6. The method according to claim 5, wherein the current sensor is a Hall effect sensor.

7. The method according to claim 5, wherein the current sensor is a low-level resistor.

8. The method according to claim 5, wherein detecting the failing of the dense battery cell comprises detecting when a current between the fast battery cell and the dense battery cell approaches a predetermined limit.

9. The method according to claim 8, wherein disconnecting the dense battery cell comprises opening the dense intervening switch between the fast and dense battery cells.

10. The method according to claim 9, wherein detecting the failing of the fast battery cell comprises detecting when a current between the fast battery cell and the dense battery cell is greater than a predetermined maximum acceptable level.

11. The method according to claim 10, wherein disconnecting the fast battery cell comprises opening the fast intervening switch between the fast battery cell and the output node and opening the dense intervening switch between the fast battery cell and the dense battery cell.

12. The method according to claim 11, further comprising connecting the dense battery cell to the output node by closing the third intervening switch between the dense cell and the output node, so that the dense battery cell powers the stimulation device functions.

13. The method according to claim 12, wherein providing the warning signal comprises delivering a patient alarm upon disconnecting the failing battery cell by delivering an electrical stimulation to an excitable tissue, causing a sensation that is perceivable by the patient.

14. The method according to claim 12, wherein providing a warning signal comprises delivering an audible sound.

15. The method according to claim 1, wherein the fast battery cell is a lithium silver vanadium oxide cell.

16. The method according to claim 1, wherein the dense battery cell is a lithium carbon monofluoride cell.

17. The method according to claim 1, wherein the implantable medical device is an implantable defibrillator.

18. An implantable cardiac stimulation device capable of using a multiple cell power supply, the device comprising:

a fast battery cell connected to an output node to power stimulation device functions, and to a dense battery cell having a greater power capacity than the fast battery cell, so that the dense battery cell is capable of recharging the fast battery cell upon demand;

a sensor that detects if the fast battery cell or dense battery cell becomes a failing battery cell;

a switch that electrically disconnects the failing battery cell from the other battery cell and from the output node, and that further connects the other battery cell to the output node; and

a warning mechanism that provides a warning signal based on detection of the failing battery cell.

19. The stimulation device according to claim 18, wherein the fast battery cell and the output node are connected by a fast intervening switch that is normally closed, so that the fast battery cell substantially provides the energy required by the output node.

20. The stimulation device according to claim 19, wherein the fast battery cell and the dense battery cell are connected by a dense intervening switch that is normally closed, so that as energy is drawn from the fast battery cell by the output node, the fast battery cell is recharged by current flowing from the dense battery cell.

21. The stimulation device according to claim 20, wherein the dense battery cell and the output node are connected by a third intervening switch that is normally open.

22. The stimulation device according to claim 21, wherein the sensor is a current sensor that detects the failing battery cell by measuring a signal proportional to a current flow from the dense cell to the fast cell.

23. The stimulation device according to claim 21, wherein the sensor is a current sensor that detects the failing battery cell by detecting when a current between the fast battery cell and the dense battery cell approaches a predetermined limit.

24. The stimulation device according to claim 21, wherein the sensor is a current sensor that detects the failing of the fast battery cell by detecting when a current between the fast battery cell and the dense battery cell is greater than a predetermined maximum acceptable level.

25. An implantable cardiac stimulation device capable of using a multiple cell power supply, the device comprising:

a fast energy storage means connected to an output node to power stimulation device functions, and to a dense energy storage means having a greater power capacity than the fast energy storage means, so that the dense energy storage means is capable of recharging the fast energy storage means upon demand;

sensing means for detecting a failing energy storage means;

means for electrically disconnecting the failing energy storage means from a non failing energy storage means and from the output node, and for allowing the non failing energy storage means to replace the failing energy storage means in powering the stimulation device functions; and

means for providing a warning signal upon disconnection of the failing energy storage means.

26. The stimulation device according to claim 25, wherein the fast energy storage means and the output node are connected by a switching means so that the fast energy storage means substantially provides the energy required by the output node.

27. The stimulation device according to claim 26, wherein the fast energy storage means and the dense energy storage means are connected by the switching means, so that as energy is drawn from the fast energy storage means by the output node, the fast energy storage means is recharged by current flowing from the dense energy storage means.

28. The stimulation device according to claim 27, wherein the sensing means detects the failing energy storage means by measuring a signal proportional to a current flow from the dense cell to the fast cell.

29. The stimulation device according to claim 27, wherein the sensing means detects the failing energy storage means by detecting when a current between the fast energy storage means and the dense energy storage means approaches a predetermined limit.

30. The stimulation device according to claim 27, wherein the sensing means detects the failing of the fast energy storage means by detecting when a current between the fast energy storage means and the dense energy storage means is greater than a predetermined maximum acceptable level.

31. A method of using a multiple cell power supply in an implantable cardiac stimulation device, comprising:

connecting a first battery cell to an output node to provide power for stimulation device functions;

connecting the first battery cell to a second battery cell so that the second battery cell is capable of recharging the first battery cell upon demand;

detecting if the first or second battery cell becomes a failing battery cell;

electrically disconnecting the failing battery cell;

if the other battery cell is not connected to the output node, connecting the other battery cell to the output node; and

providing a warning signal after detecting the failing battery cell.